GUJARAT TECHNOLOGICAL UNIVERSITY

BRANCH NAME: INFORMATION AND COMMUNICATION TECHNOLOGY
SUBJECT NAME: SATELLITE COMMUNICATION AND NETWORKING
SUBJECT CODE: 2173207
B.E. 7th SEMESTER

Type of course: Undergraduate

Prerequisite: Analog and Digital Communication

Rationale: The course aims to:
1 To understand the basics of satellite communications
2 To understand different satellite communication orbits
3 To understand the satellite segment and earth segment
4 Provide an in-depth treatment of satellite communication systems operation and planning
5 To analyze the various methods of satellite access
6 Link budgets & planning
7 Review the state of the art in new research areas such as speech and video coding, satellite Networking and satellite personal communications

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P	C	Theory Marks			Practical Marks			
				ESE (E)	PA (M)		ESE (V)		PA (I)	
					PA	ALA	ESE	OEP		
4	0	2	6	70	20	10	20	10	20	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	**Introduction to Satellite Communication:** Historical background, Basic concepts of Satellite Communications, Communication Networks and Services, Comparison of Network Transmission technologies, Orbital and Spacecraft problems, Growth of Satellite communications.	**2**	**5**
2	**Orbits and Launching Methods:** Introduction, Kepler's First Law,Kepler's Second Law, Kepler's Third Law, Definitions of Terms for Earth-Orbiting Satellites, Orbital Elements, Apogee and Perigee Heights, Orbit Per turbations, Effects of a non spherical earth, Atmospheric drag.	**5**	**10**
3	**The Geostationary Orbit:** Introduction, Antenna Look Angles, The Polar Mount Antenna, Limits of Visibility, Near Geostationary Orbits, Earth Eclipse of Satellite, Sun Transit Outage, Launching Orbits	**4**	**10**

4	**Radio Wave Propagation:** Introduction, Atmospheric Losses, Ionospheric Effects, Rain Attenuation, Other Propagation Impairments	**2**	**5**
5	**Polarization:** Introduction, Antenna Polarization, Polarization of Satellite Signals, Cross Polarization, Discrimination, Ionospheric Depolarizaon, Rain Depolarization, Ice Depolarization	**2**	**5**
6	**The Space Segment :** Introduction, The Power Supply, Attitude Control, Spinning satellite stabilization, Momentum wheel stabilization, Station Keeping, Thermal Control, TT&C Subsystem, Transponders, The wideband receiver, The input demultiplexer, The power amplifier, The Antenna Subsystem	**4**	**15**
7	**The Earth Segment:** Introduction, Receive-Only Home TV Systems, The outdoor unit, The indoor unit for analog (FM) TV, Master Antenna TV System, Community Antenna TV System, Transmit-Receive Earth Stations	**4**	**10**
8	**The Space Link :** Introduction, Equivalent Isotropic Radiated Power, Transmission Losses, Free-space transmission, Feeder losses, Antenna misalignment losses, Fixed atmospheric and ionospheric losses, The Link-Power Budget Equation, System Noise, Carrier-to-Noise Ratio, The Uplink, Saturation flux density, Input backoff, Downlink, Output back-off, Combined Uplink and Downlink C/N Ratio	**5**	**15**
9	**Satellite Access:** Introduction, Single Access, Preassigned FDMA, Demand-Assigned FDMA, Spade System, TDMA, Preassigned TDMA, Demand-assigned TDMA, Satellite-Switched TDMA, Code-Division Multiple Access	**4**	**10**
10	**Satellite in Networks:** Introduction, Network Basics, Asynchronous Transfer mode(ATM), ATM over satellite**,** the internet, internet layers, The TCP Link, Satellite link and TCP, Enhancing TCP over satellite channels using Standard Mechanics(RFC-2488)	**7**	**15**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
15	**15**	**10**	**10**	**10**	**10**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

1. Satellite Communications, by Dennis Roddy (Fourth edition),McGraw Hill.
2. Satellite Communication Systems Engineering, by Wilbur L. Pritchard, Henri G. Suyderhoud, Robert A. Nelson (Second Edition), Pearson
3. Satellite Communication, by Timothy Pratt, Charles Bostian, Jeremy Allnutt(Second Edition), John Wiley & Sons.
4. Satellite Technology, Principles and Applications, by Anil K. Maini, Varsha Agarwal (Second Edition), Wiley.

Course Outcome:

After successful completion of the course, the students will be able to:
1. Understand principle, working and operation of various sub systems of satellite as well as the earth station.
2. Apply various communication techniques for satellite applications
3. Analyze and design satellite communication link
4. Learn advanced techniques and regulatory aspects of satellite communication
5. Understand role of satellite in various applications

Suggested List of Experiments:

1. Understanding the basic concepts of satellite communication
2. To setup a communication link between uplink transmitter and downlink receiver using Satellite.
3. To setup an Active satellite communication link and demonstrate link fail operation
4. To communicate voice & Video signal through satellite link
5. Observe the effect of Different combinations of uplink and downlink frequencies on satellite link.
6. To transmit and receive three separate signals (Audio, Video , Tone) simultaneously through satellite link
7. To transmit and receive function generator signals through satellite link.
8. To measure the signal parameters in analog FM/FDM TV satellite link.
9. To transmit digital waveforms through a satellite communication link.
10. To Calculate Bit Error Rate in a satellite communication link.

Design based Problems (DP)/Open Ended Problems:

1. To write a program to observe the variations in the antenna look angles for the earth station antennas.
2. To write a program to calculate to determine the limits of visibility for an earth station.
3. To obtain the plot of Orbital altitude versus satellite antenna diameter.
4. To write a Program for Estimated tropospheric attenuation due to Oxygen and water.
5. To write a Program for plot of Semi major axis versus rate of change of argument of perigee.
6. To write program to calculate the rain attenuation (in dB) for horizontal polarization, vertical polarization and circular polarization for satellite wave propagation.
7. To write a program to determine the combined carrier to noise power spectral density ratio for satellite link budget.
8. To determine the degradation in the downlink C/I ratio when satellite orbital spacing is reduced.

9. To write a program to plot the degradation in downlink C/I.

10. To plot the variation in Carrier to Noise power spectral density ratio(uplink, downlink and combined)for changes in the input SFD for uplink and EIRP for downlink.

11. To write a program for plotting Half power beam width Vs. Maximum number of days sun transit occursat an earth station.

12. To write a program for plotting BER vs Eb/No for BPSK signal for Sat Com.

List of Open Source Software/learning website:

1. http://nptel.iitm.ac.in/course.php
2. http://ocw.mit.edu
3. www.radio-electronics.com
4. http://en.wikipedia.org
5. www.youtube.com

ACTIVE LEARNING ASSIGNMENTS:

Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to GTU.